

**Characterization
Report for the
903 Drum
Storage Area,
903 Lip Area, and
Americium Zone**

**RF/RMRS-99-427.UN
Rev.1**

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Final**

ACRONYMS

ALF	Action Levels & Standards Framework for Surface Water, Groundwater & Soil
Am	Americium
bgs	below ground surface
C	Carbon
CCL ₄	Carbon Tetrachloride
CDH	Colorado Department of Health
CDPHE	Colorado Department of Health and Environment
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
cm	centimeter
cpm	counts per minute
COC	Contaminant of Concern
CRQL	Contract Required Quantitation Limit
1,2-DCE	1,2-Cis-Dichloroethylene
DER	Duplicate Error Ratio
DNAPL	Dense Nonaqueous Phase Liquid
DOE	U. S. Department of Energy
DOT	Department of Transportation
DQA	Data Quality Assessment
DQO	Data Quality Objective
EPA	Environmental Protection Agency
Eq	Equation
FIDLER	Field Instrument for the Detection of Low Energy Radiation
FOV	Field of View
g/cc	density (gram/cubic centimeter)
HPGe	High Purity Germanium Detector
IHSS	Individual Hazardous Substance Site
IM/IRA	Interim Measures/Interim Remedial Action
ISOCs	In Situ Object Counting System
kg	kilogram
K-H	Kaiser-Hill Company, L.L.C.
m	meter
MeV	Value of Energy
mg/L	micrograms per liter
MS/MSD	Matrix Spike/Matrix Spike Duplicate
NIST	National Institute of Standards and Technology
OU	Operable Unit
PARCC	Precision, Accuracy, Representativeness, Completeness, & Comparability
PCE	Tetrachloroethene
pCi/g	picocuries per gram
Pu	Plutonium
QA	Quality Assurance
QAPD	Quality Assurance Program Description
RCRA	Resource Conservation and Recovery Act
RFCA	Rocky Flats Cleanup Agreement
RFETS	Rocky Flats Environmental Technology Site
FFFO	Rocky Flats Field Office
RFI/RI	RCRA Facility Investigation/Remedial Investigation
RIN	Routine Identification Number
RMRS	Rocky Mountain Remediation Services, L.L.C.
RPD	Relative Percent Difference
RSAL	Radionuclide Soil Action Level
RWP	Radiation Work Permit
SAP	Sampling and Analysis Plan

SOR	Sum of Ratios
SSAL	Subsurface Soil Action Level
TCE	Trichloroethene
TMU	Total Measurement Uncertainty
TPU	Total Propagated Uncertainty
U	Uranium
UCL	Upper Confidence Limit
ug/kg	micrograms/kilogram
ug/L	microgram per liter
V&V	Verification/Validation
VOC	Volatile Organic Compound
WAC	Waste Acceptance Criteria

EXECUTIVE SUMMARY

Investigation of soil contamination at the 903 Drum Storage Area (903 Pad), 903 Lip Area (Lip Area), and Americium Zone was performed to provide characterization data for subsequent evaluation of remedial alternatives for site cleanup. Historically, drums which were stored at the 903 Pad between 1958 and 1967 leaked hydraulic fluids and lathe coolant containing plutonium and depleted uranium. This release contaminated surface and subsurface soil with radionuclides and volatile organic compounds (VOCs). The VOCs have migrated into the shallow groundwater system beneath the 903 Pad.

The primary purpose of this investigation was to estimate the volume of contaminated soil above the Rocky Flats Cleanup Agreement (RFCA) Tier I Radionuclide Soil Action Levels (RSALs) and Subsurface Soil Action Levels (SSALs). Another objective of the investigation was to characterize surface soil to 10 pCi/g americium-241 (^{241}Am) using gamma spectroscopy field instrumentation. This characterization would allow for identification of surface soils exceeding Tier II RSALs. Remedial alternatives will be evaluated in the Interim Measure/Interim Remedial Action (IM/IRA) Decision Document based on these volume estimates.

Delineation of radiologically-contaminated soil in the Americium Zone was performed *insitu* using gamma-ray spectroscopy methods, which employ a high purity germanium detector (HPGe). The HPGe instrument was used to obtain 1110 contiguous gamma ray measurements with a circular field of view of 10 meters in diameter within the investigation area. Given this coverage, nearly the entire Americium Zone within the investigation area was surveyed for radionuclides.

The HPGe measurement results were correlated with alpha spectroscopy measurements of radionuclides in eight co-located surface soil samples. The resulting best-fit regression model was used to standardize each HPGe ^{241}Am measurement to a laboratory-derived ^{241}Am and plutonium-239/240 ($^{239/240}\text{Pu}$) alpha spectroscopy measurement. The correlation results for ^{241}Am and $^{239/240}\text{Pu}$ were input into the Tier I and II RSAL sum of ratios equations to determine HPGe measurements locations exceeding the respective action levels.

Based on the standardized HPGe results, surface soil at approximately 37% of the HPGe measurement locations within the Americium Zone has radionuclides exceeding the Tier II RSALs. HPGe results that exceed Tier I RSAL are isolated at a cluster of three locations near the northwest corner of the Americium Zone and at one location in the south central portion of the Lip Area. The Tier I and Tier II RSAL exceedances are a result of elevated activities of $^{239/240}\text{Pu}$ and ^{241}Am . Within the Americium Zone, $^{239/240}\text{Pu}$ activities ranged from 6.32 pCi/g to 938.42 pCi/g and ^{241}Am activities ranged from 4.91 pCi/g to 149.22 pCi/g.

Contamination of surface and subsurface soils at the 903 Pad and Lip Area was delineated with data obtained from borings at evenly spaced grid nodes. Radiological samples from 79 boring locations were analyzed for ^{241}Am , $^{239/240}\text{Pu}$, uranium-233/234 ($^{233/234}\text{U}$), uranium-235 (^{235}U), and uranium-238 (^{238}U) using alpha spectroscopy. VOC samples were collected from 17 boring locations and were analyzed for VOC contaminants of concern which included carbon tetrachloride (CCL_4), chloroform, cis-1,2-dichloroethene (1,2-DCE), methylene chloride, tetrachloroethene (PCE), and trichloroethene (TCE).

Based on the data obtained from borings in the 903 Pad and Lip Area, most of the surface soil (0 to 6 inches) is contaminated above Tier I and Tier II RSALs. $^{239/240}\text{Pu}$ and ^{241}Am activities within the 903 Pad and Lip Area ranged from 0.82 pCi/g to 152,260 pCi/g and 0.15 pCi/g to 31,670 pCi/g, respectively. Radiological contamination was also detected in the subsurface soil at depths of 6 to 12 inches and 12 to 18 inches within the 903 Pad and Lip Area; however, $^{239/240}\text{Pu}$ and ^{241}Am activities decreased by orders of magnitude at progressively deeper soil horizons.

Artificial fill at the 903 Pad is contaminated above the RFCA Tier II RSALs at one location (Boring 91898). Soil at this boring has elevated levels of ^{241}Am (126 pCi/g) and $^{239/240}\text{Pu}$ (558 pCi/g). Asphalt samples from the 903 Pad were also collected for waste characterization profiling but were not compared to RFCA Tier I and Tier II RSALs.

Contaminated soil volumes are based on the areas and depths of Tier I and Tier II RSAL exceedances. The total volume of contaminated soil exceeding Tier I RSALs is 2,925 yd³. The total volume of soil exceeding Tier II RSALs is estimated at 14,307 yd³. Relative to Tier II RSAL exceedances, the amount of radiologically-contaminated soil at the 903 Pad is 2,471 yd³; 4,811 yd³ in the Lip Area; and 7,025 yd³ in the Americium Zone.

No VOCs were detected in subsurface soil above the current SSALs within the 903 Pad and Lip Area. However, methylene chloride, PCE, TCE and 1,2-DCE exceeded proposed Tier I and Tier II SSALs in several borings near well 08891. The total

volumes of contaminated soil above proposed Tier I and Tier II SSALs are 4,237 yd³ and 6,813 yd³, respectively. In addition, 317 yd³ of contaminated soil containing elevated levels of both radionuclides and VOCs are also present.